Small Business Innovation Research/Small Business Tech Transfer

Distributed Fiber Optic Sensing System, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

To meet the NASA need for high accuracy, light weight, low power fiber optic sensing system for Entry, Descent, and Landing (EDL) instrumentation systems, RC Integrated Systems LLC (RISL) proposes to develop a novel Distributed Fiber Optic Sensing (DFOS) System providing accurate in situ measurement of multiple thermal protection system (TPS) structural, aerothermal, and aerodynamic response parameters including temperature, pressure/strain, and heat flux. The DFOS is based on use of novel materials for high-temperature operation and uniquely designed fiber optic sensors. The DFOS system is capable of simultaneously measuring multiple TPS response parameters (e.g., pressure, strain, temperature, and heat flux) from thousands of sensing locations by emplacing a single optical fiber onto the TPS structure. DFOS will tolerate operating temperatures up to1800 degrees C and achieve measurement errors within +/- 5 degrees C for temperature sensors and +/-1% for pressure sensors. In Phase I RISL will demonstrate the feasibility of DFOS for in-situ measurement of DFOS feasibility by fabricating and testing a technology readiness level (TRL)-4 prototype, with the goal of achieving TRL-6 by the end of Phase II.

Anticipated Benefits

The proposed technology will provide for NASA a distributed and embedded in situ system for measurement of thermal protection system (TPS) temperature, strain, heat flux, and surface pressure with high accuracy and high spatial resolution. The proposed system will provide better traceability from the modeling and design tools to actual performance, because the resultant sensor data can lead to higher-fidelity design tools, improved risk quantification, decreased heat shield mass, and increase in direct payload. The proposed system can be applied to different types TPS materials for planetary aerocapture and entry as well as return to Earth. The proposed technology will directly support future NASA missions.

The military will benefit from this technology by incorporating the proposed system into the aircraft structural components to monitor, in situ and in real time, potential component failure, to reduce the amount of inspection and testing required, and increase reliability and mission availability. Commercial applications include health monitoring of commercial aircraft structural components. The sensors can also be used for damage detection of oil and gas pipelines. Harsh environment applications of the system include monitoring coal-fired power plants, natural-gas-based power plants, geothermal plants, as well as other power-generation facilities.

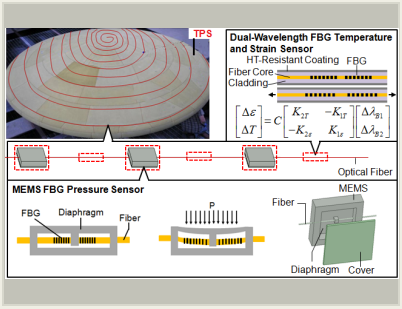

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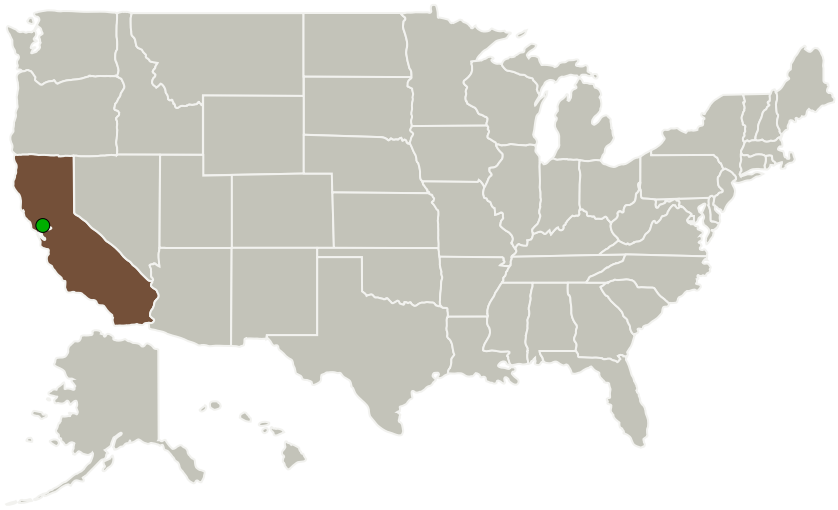
Table of Contents

Distributed Fiber Optic Sensing System, Phase I

Completed Technology Project (2018 - 2019)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
RC Integrated Systems, LLC	Lead Organization	Industry Women-Owned Small Business (WOSB)	Torrance, California
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations
California

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141327)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

RC Integrated Systems, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

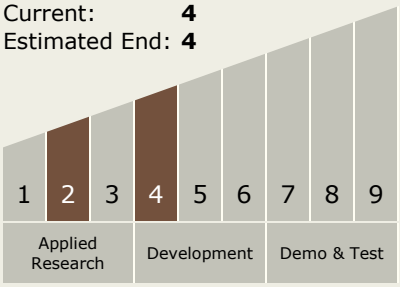
Carlos Torrez

Principal Investigator:

Naibing Ma

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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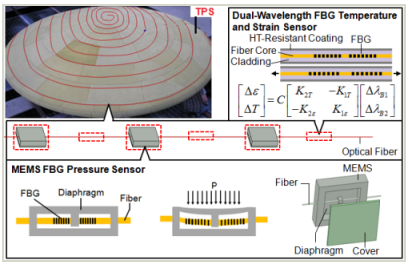
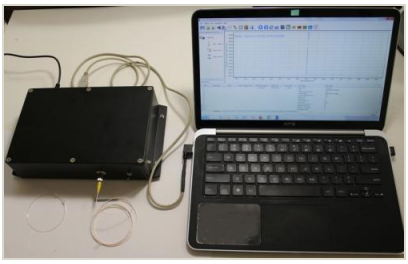
Completed Technology Project (2018 - 2019)

Images



Briefing Chart Image
Distributed Fiber Optic Sensing System, Phase I
(https://techport.nasa.gov/image/135958)



Final Summary Chart Image
Distributed Fiber Optic Sensing System, Phase I
(https://techport.nasa.gov/image/136379)

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.6 Instrumentation and Health Monitoring for EDL

Target Destinations

Earth, Mars